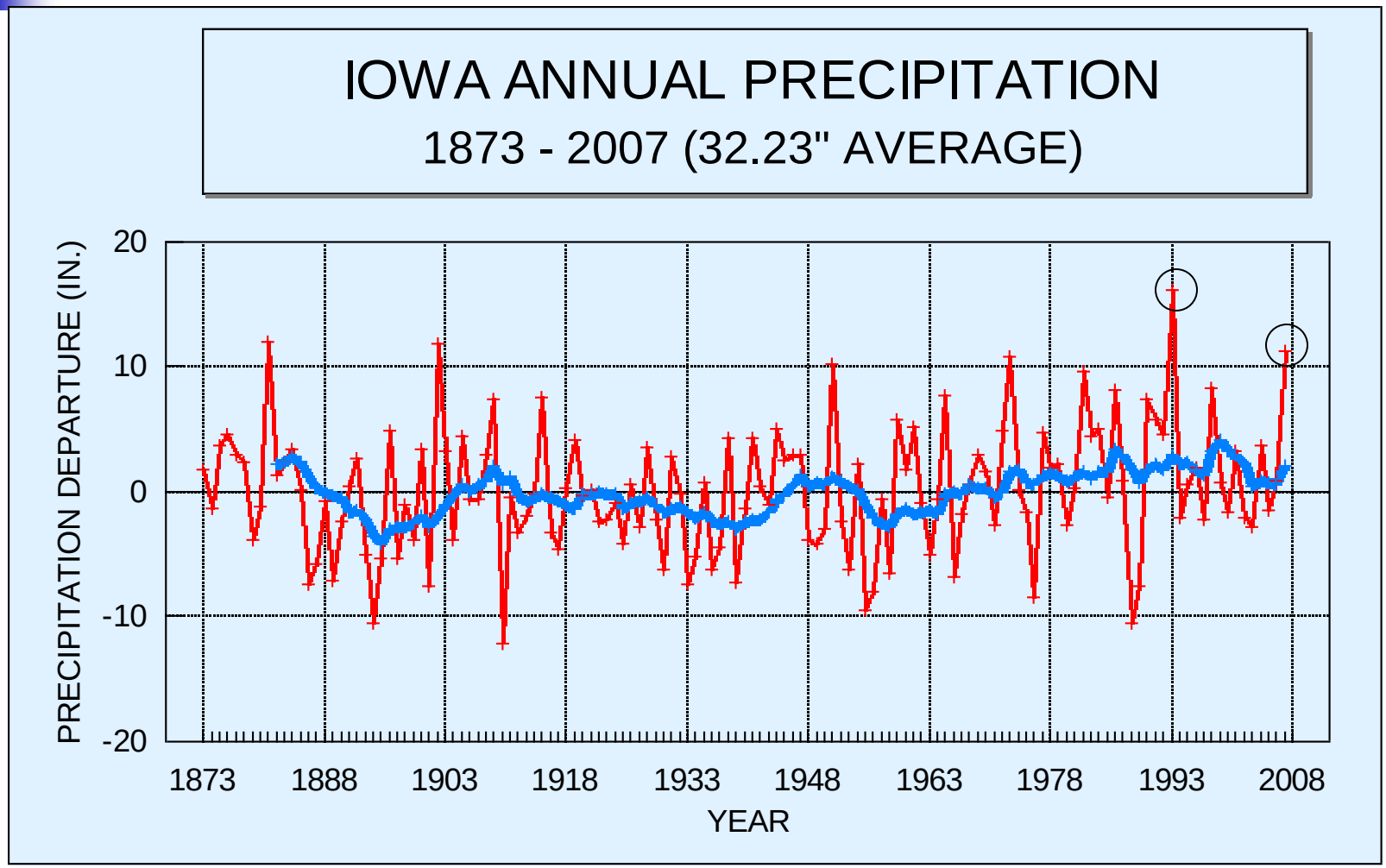
Learning From the Floods of 2008: Water Quality Issues

Mary Skopec, Ph.D.
Watershed Monitoring and Assessment Section
Iowa DNR

Presented at:
NJ Water Monitoring Council Meeting
May 30, 2012

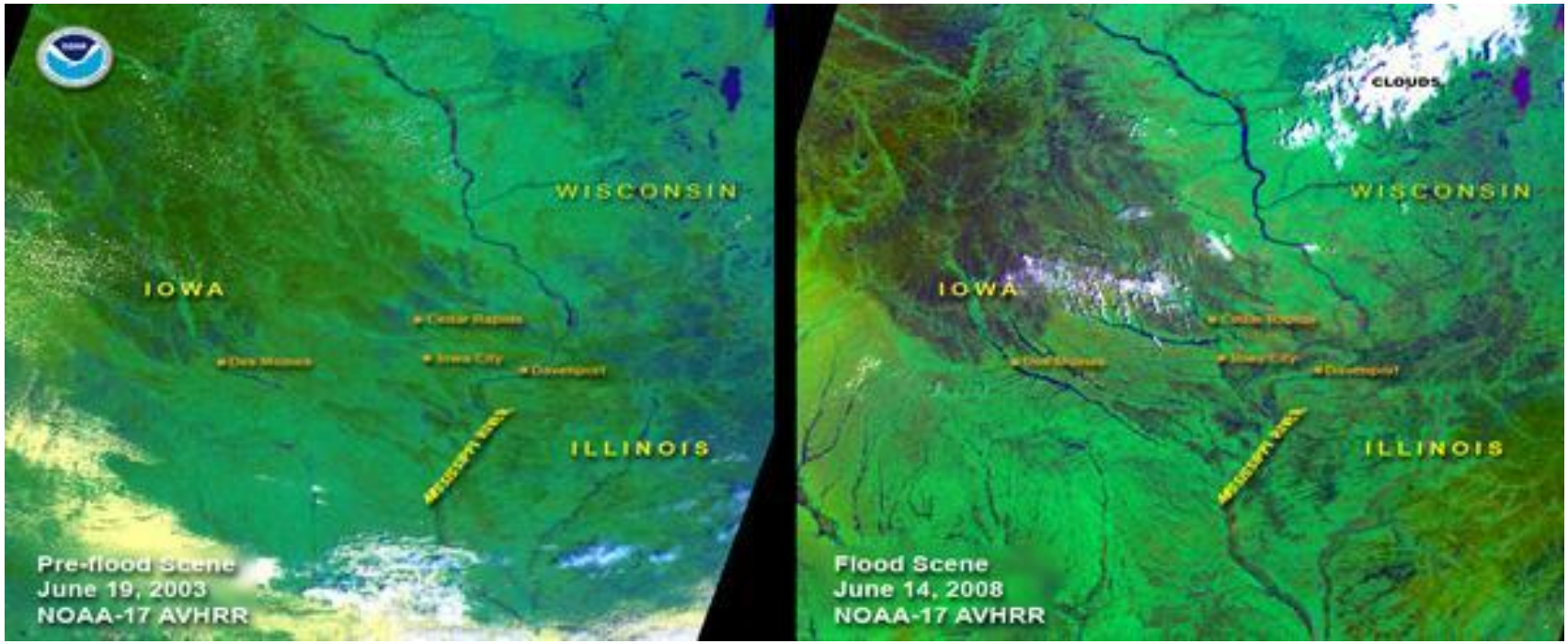
Setting the Stage



Precipitation Patterns

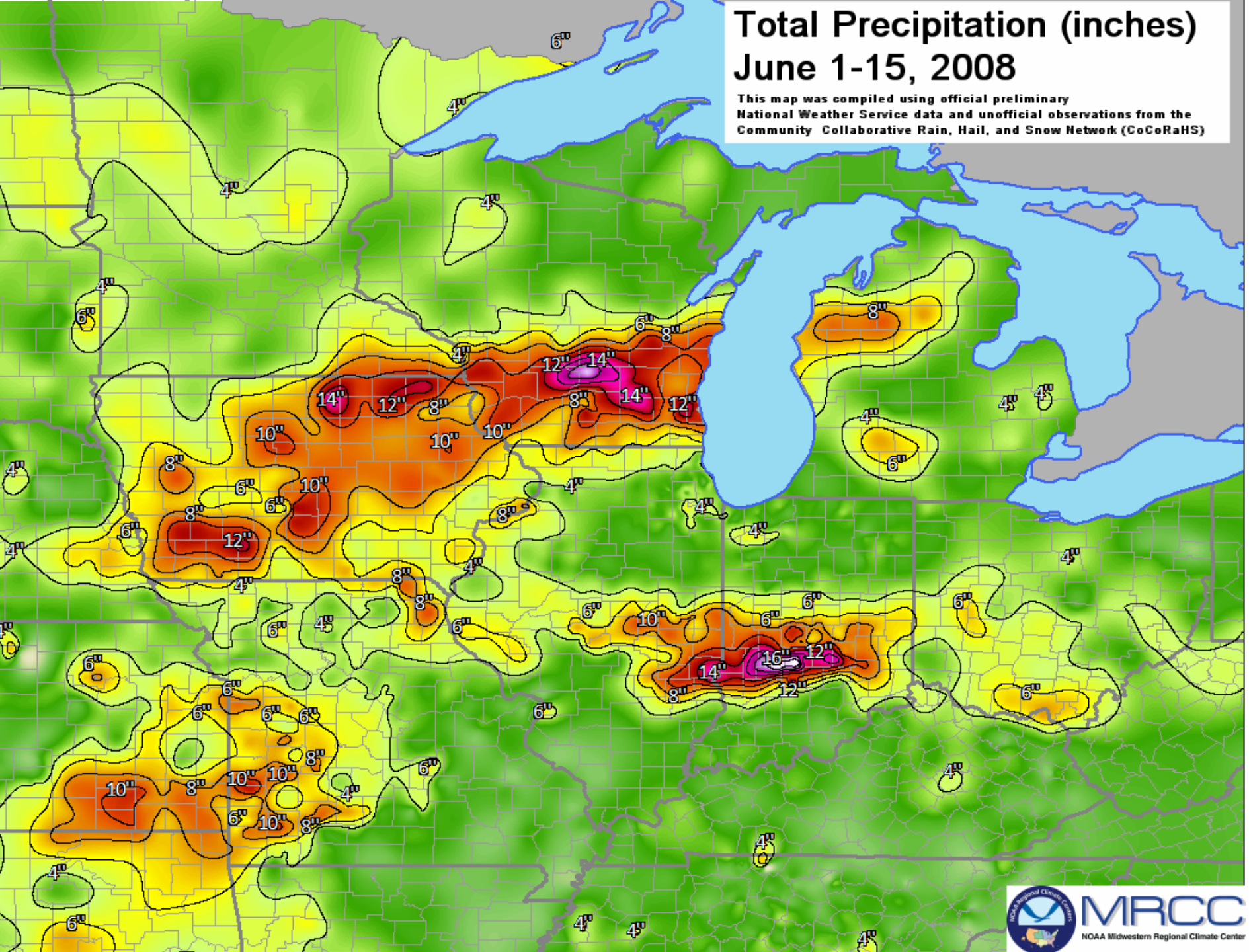
- Very wet 2007 – 4th wettest in 135 years
- Long, cold 2007-2008 winter – 21st coldest, 8th wettest
  - Record snowfall in eastern Iowa
  - Persistent snowpack into March 2008
- A cold and wet spring -2nd wettest April
- A record wet 15 days May 29-June 12

NOAA-17 AVHRR



2003

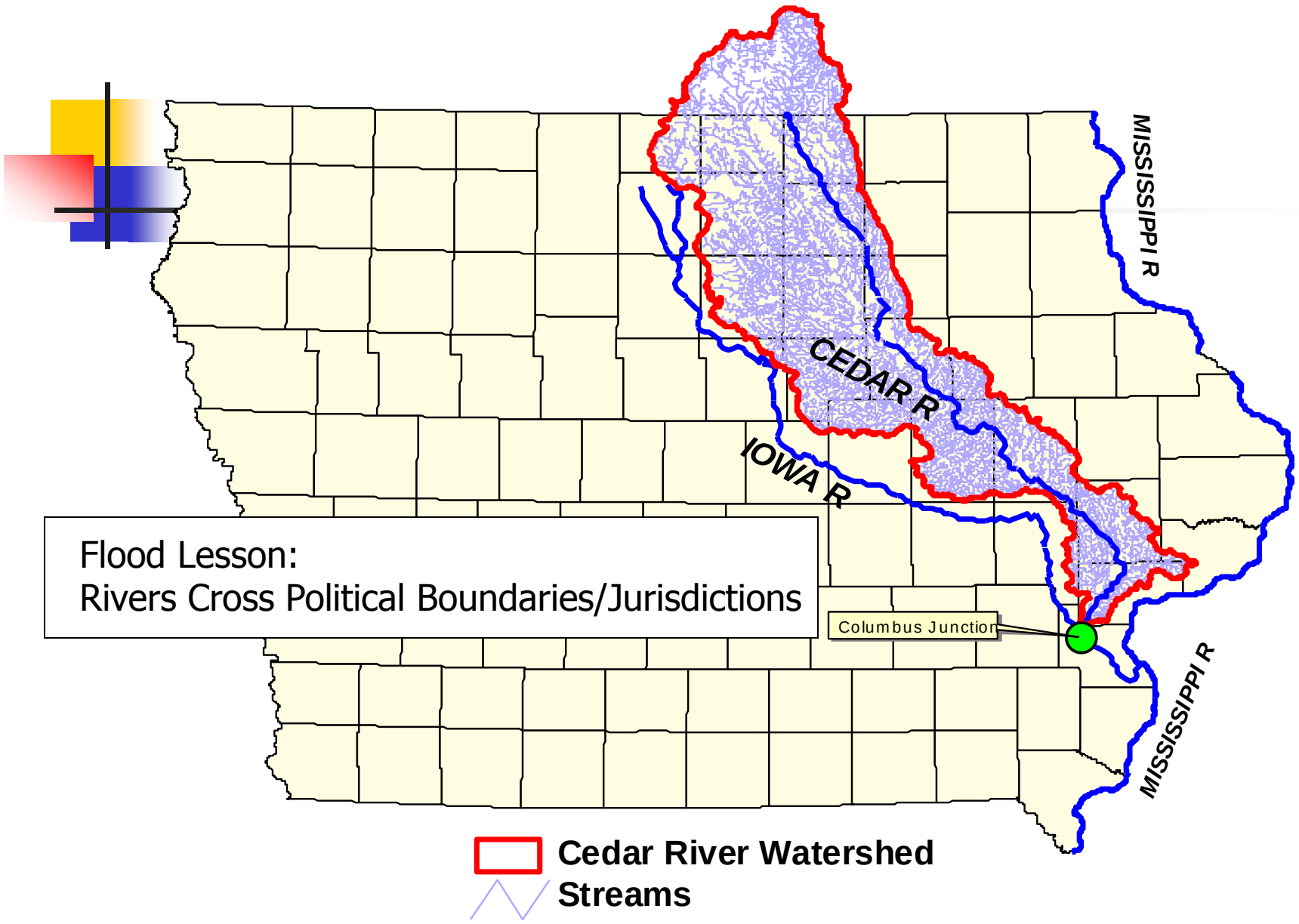
2008


Total Precipitation (inches)
June 1-15, 2008
This map was compiled using official preliminary
National Weather Service data and unofficial observations from the
Community Collaborative Rain, Hail, and Snow Network (CoCoRaHS)
MRCC
NOAA Midwestern Regional Climate Center

Learning from the Floods

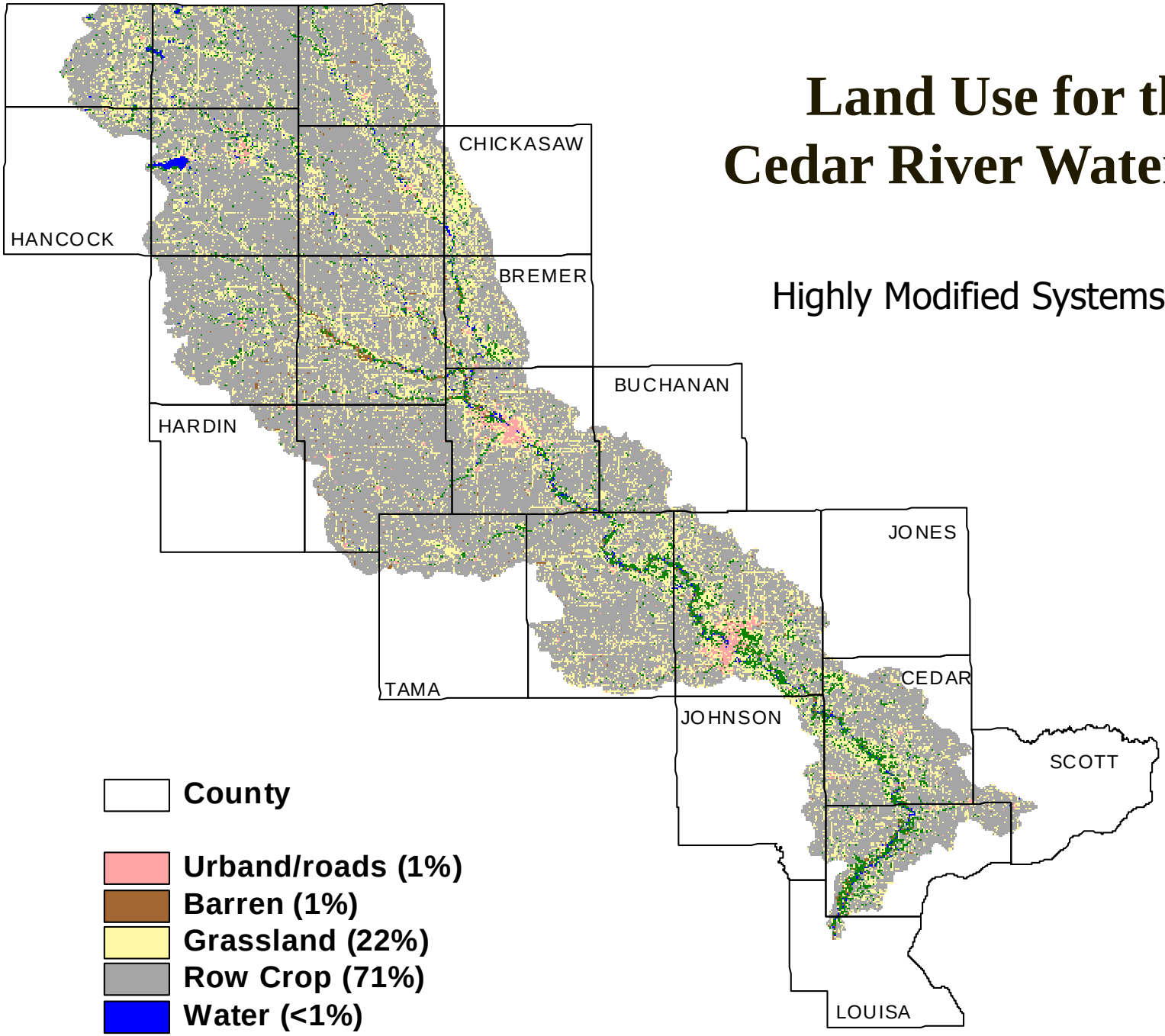
- Cedar River Example

Cedar River Watershed (7,785 square miles)



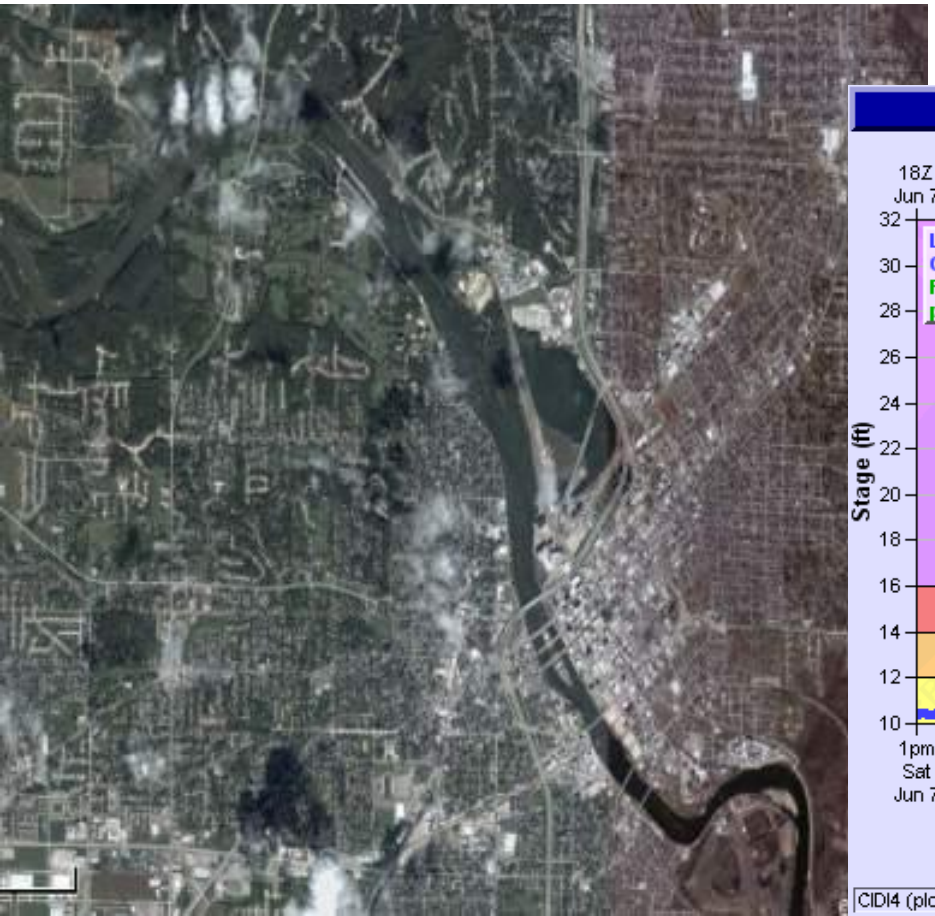
Flood Lesson:
Rivers Cross Political Boundaries/Jurisdictions

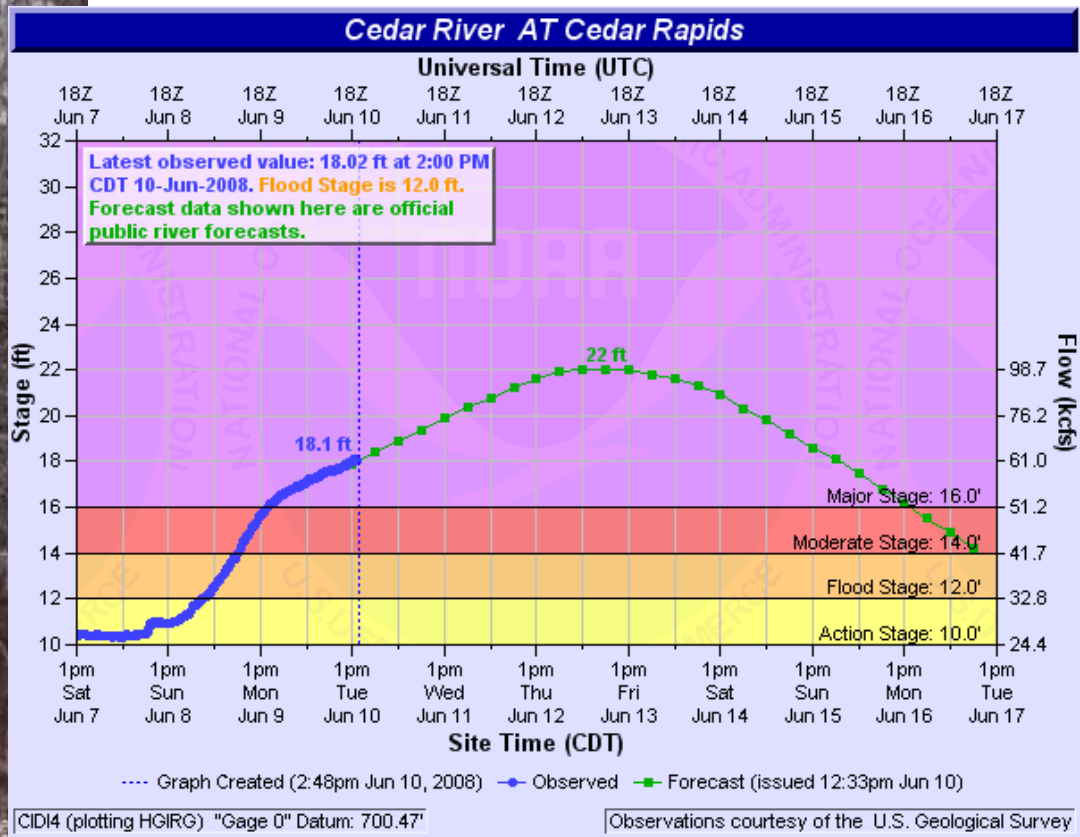
Land Use for the Cedar River Watershed



Cedar Rapids – Cedar River

- Crest: 22
- DTG: 121300JUN08
- Known Affects:
  - @22.5 Tops CR Levee
  - Relocation of City / Fed Government
  - No Effect to Water Plant





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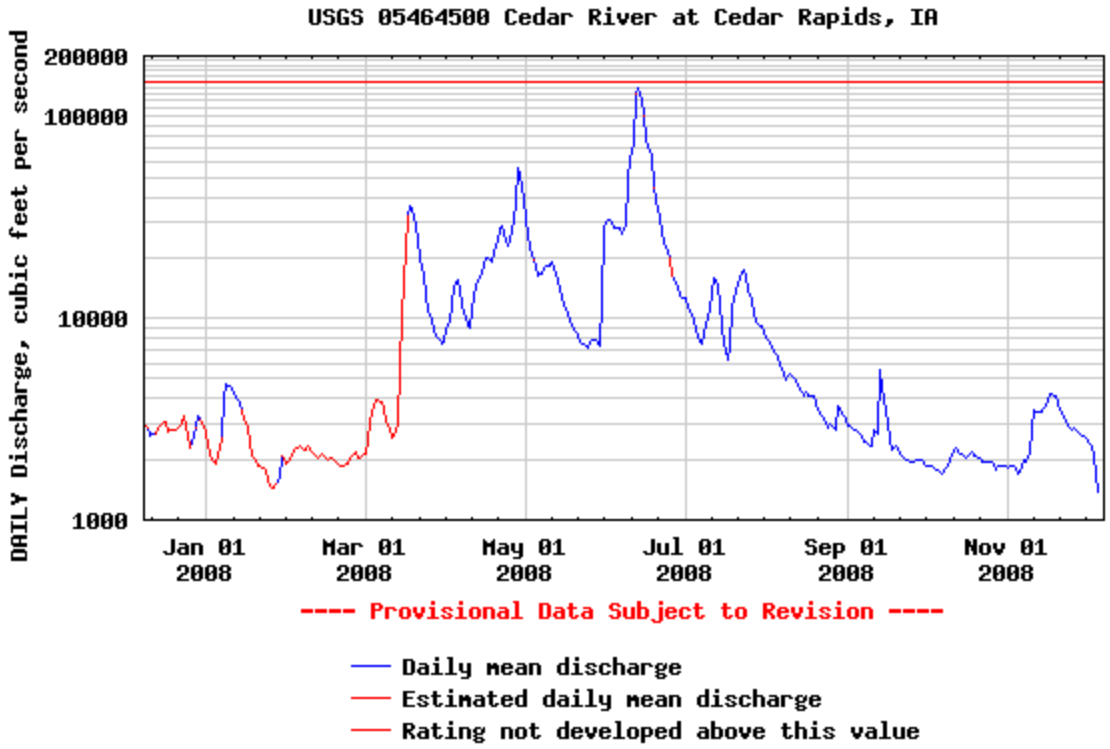
USGS Real-Time Water Data for USGS 05464500 Ced...

Cedar River at Cedar Rapids

Discharge, cubic feet per second



Cedar River Peak Flow ~140,000 cfs
Mississippi at McGregor ~97,000 cfs

Go To Cedar Rapids Flood Page……..

Flood Monitoring

- Initial Purpose:
  - Understand the long-term flood impacts
  - Status and Trends – Iowa
  - Gulf of Mexico Hypoxia
- Shift in Purpose
  - Real-time decisionmaking
  - Public health and safety

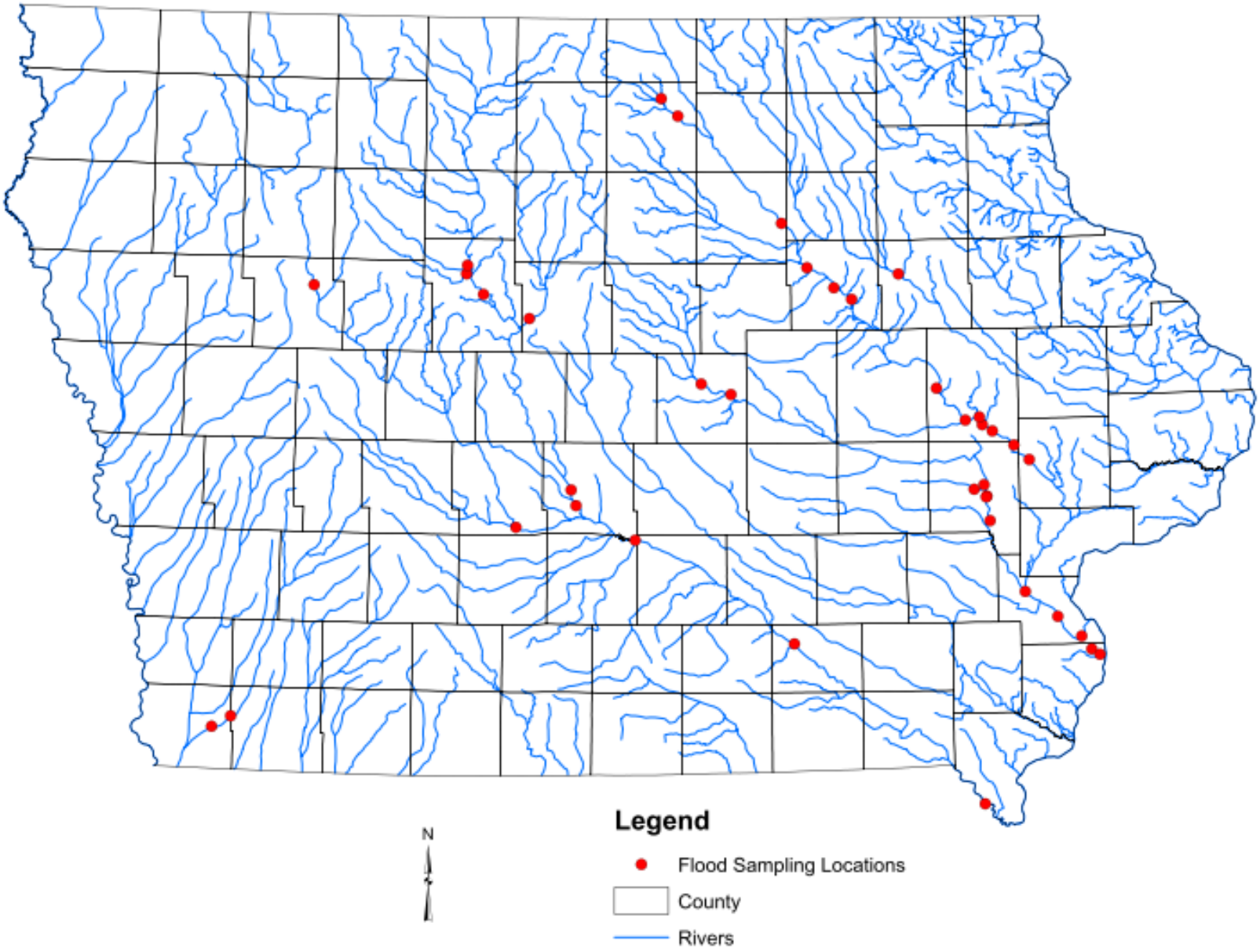
Flood Monitoring

- DNR contacted University of Iowa Hygienic Laboratory.
- Began intensive flood water monitoring on June 9th. Most sampling concluded Sept. 4th.
- Weekly samples from ambient sites located around major urban areas; supplemented sites later.
- Daily bacteria sampling downstream of Cedar Rapids, Prospect Park in Des Moines.

Flood Monitoring

- Preliminary Results from State Lab reported within a week of initial sampling.
- Contrast with 1993 where essentially no flood or post-flood monitoring was conducted by the state.

2008 Flood Monitoring Locations



Additional Sampling Due to Public Health Concerns

- Streams
  - Cedar River at Sutliff
  - Camp Cardinal Creek Coralville
  - Iowa River at Hwy 6 Iowa City
  - Prospect Park Des Moines River (bacteria only)
- Sediment
  - Cedar Rapids
  - Coralville/Iowa City
  - Waterloo/Cedar Falls
  - Oakville


Oakville, Iowa


Oakville, Iowa

Oakville, Iowa

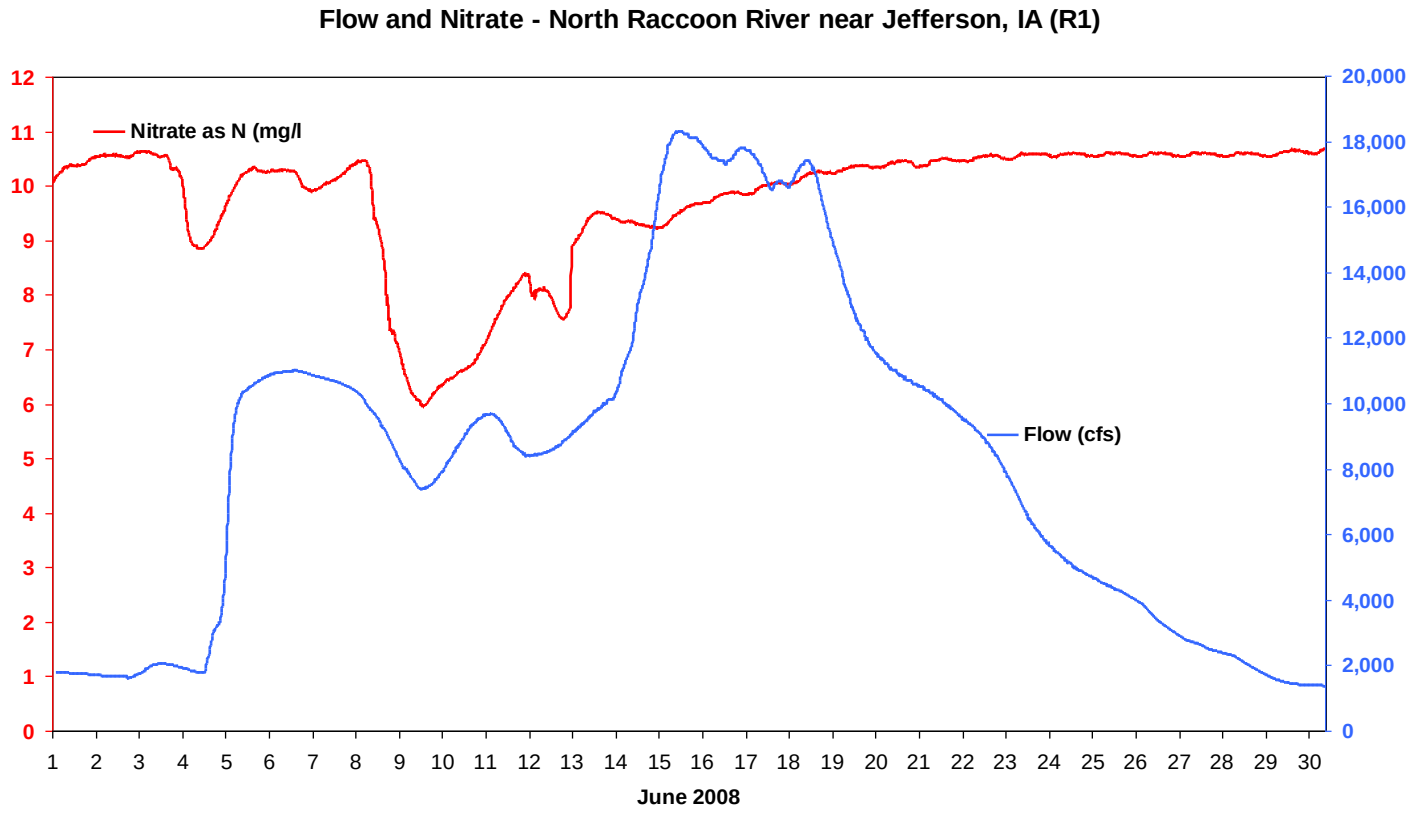
Analytes (~ 140 individual)

Test	Method
• Oil and Grease	EPA 1664
• Total Extractable Hydrocarbons	UHL OA-2
• GC/MS Volatiles	EPA 8260
• Gasoline	UHL OA-1
• Semi-volatiles	EPA 8270, PREP EPA 3510
• N & P-Containing Pesticides	EPA 507, EPA 508
• E. coli	EPA 1603
• CBOD5	SM 5210B
• Metals	EPA 200.7 or 200.8
• Ammonia Nitrogen as N	LAC10-107-06-1J
• Nitrite + Nitrate as N	EPA 353.2
• TKN	LAC10-107-06-2E
• Orthophosphate as P	LAC10-115-01-1A
• Total Phosphate as P	LAC10-115-01-1D
• Total Dissolved Solids	SM 2540C
• Total Suspended Solids	USGS I-3765-85
• Total Volatile Suspended Solids	EPA 160.4

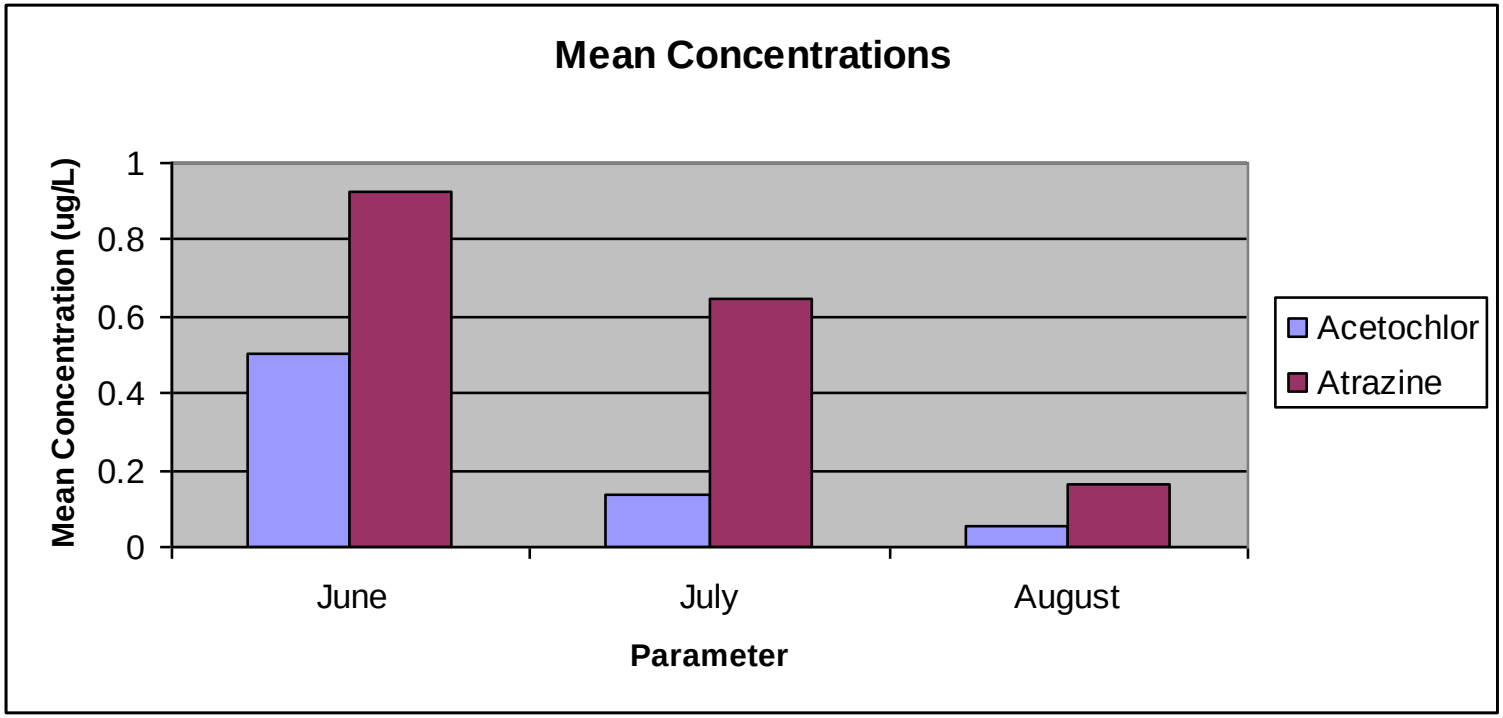
Water Samples

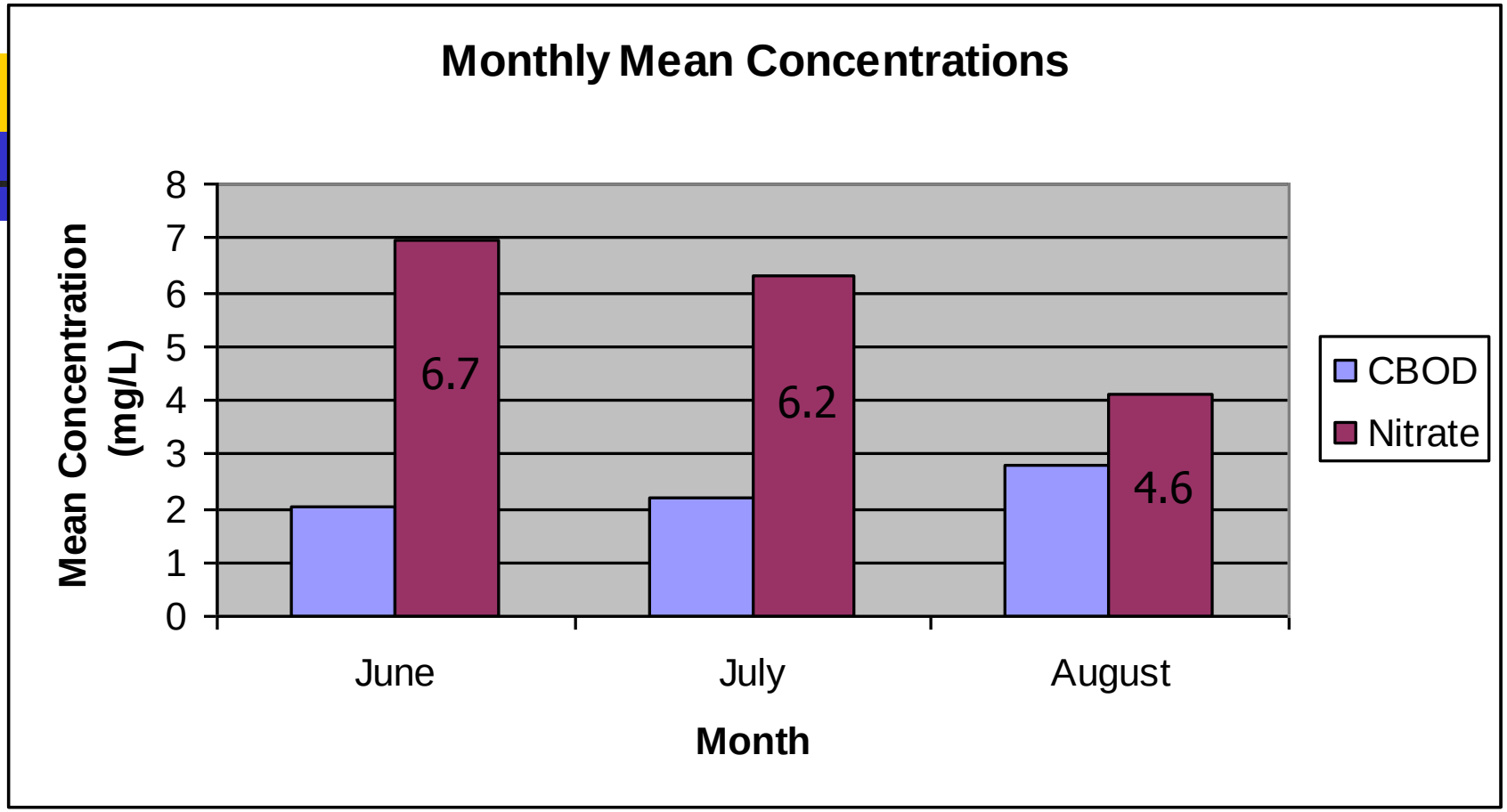
- Most analytes not detected in floodwaters
  - June 85% non-detection rate
  - July 91% non-detection rate
  - August 92% non-detection rate
- Detections of nutrients, bacteria, common herbicides
- Isolated detections of metals, volatiles, semi-volatiles
- Stray Detections of “Exotics” weeks to months after flood peak.

Dilution and Flow Impacts



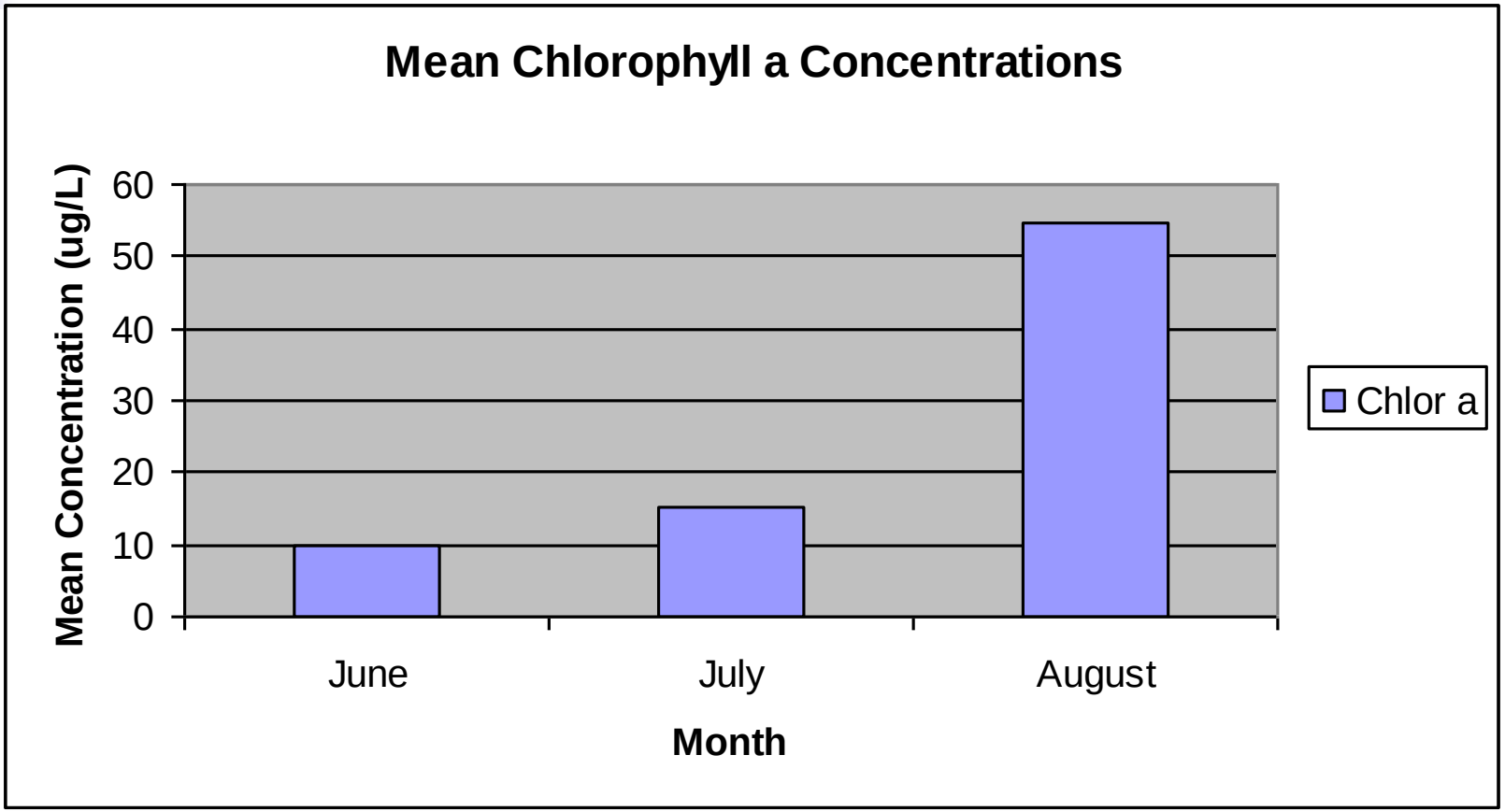
Decreasing Concentrations of Most Compounds



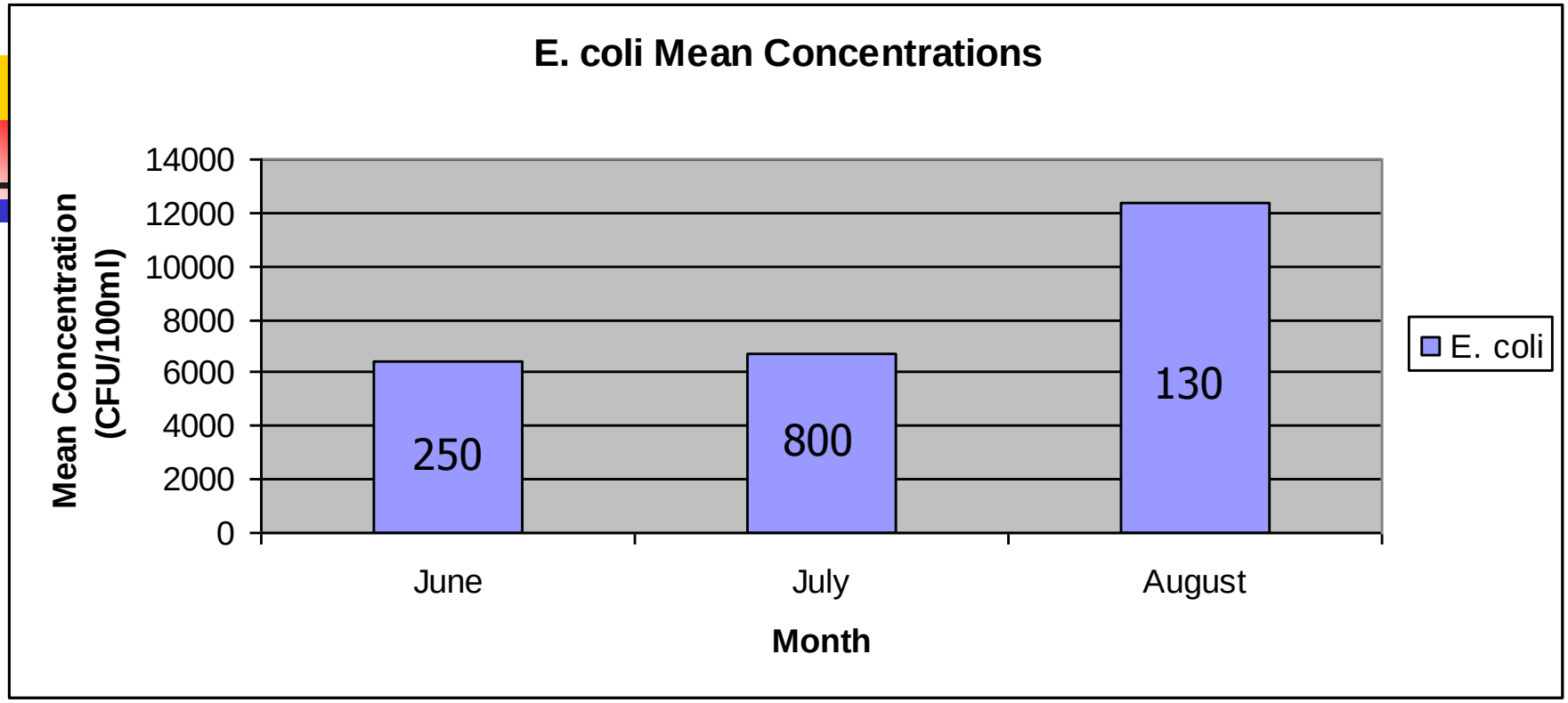


Median Concentrations (indicated on bars)
Compared to the statewide median (2000-2007; 5.7 mg/L)

Nutrient Enrichment

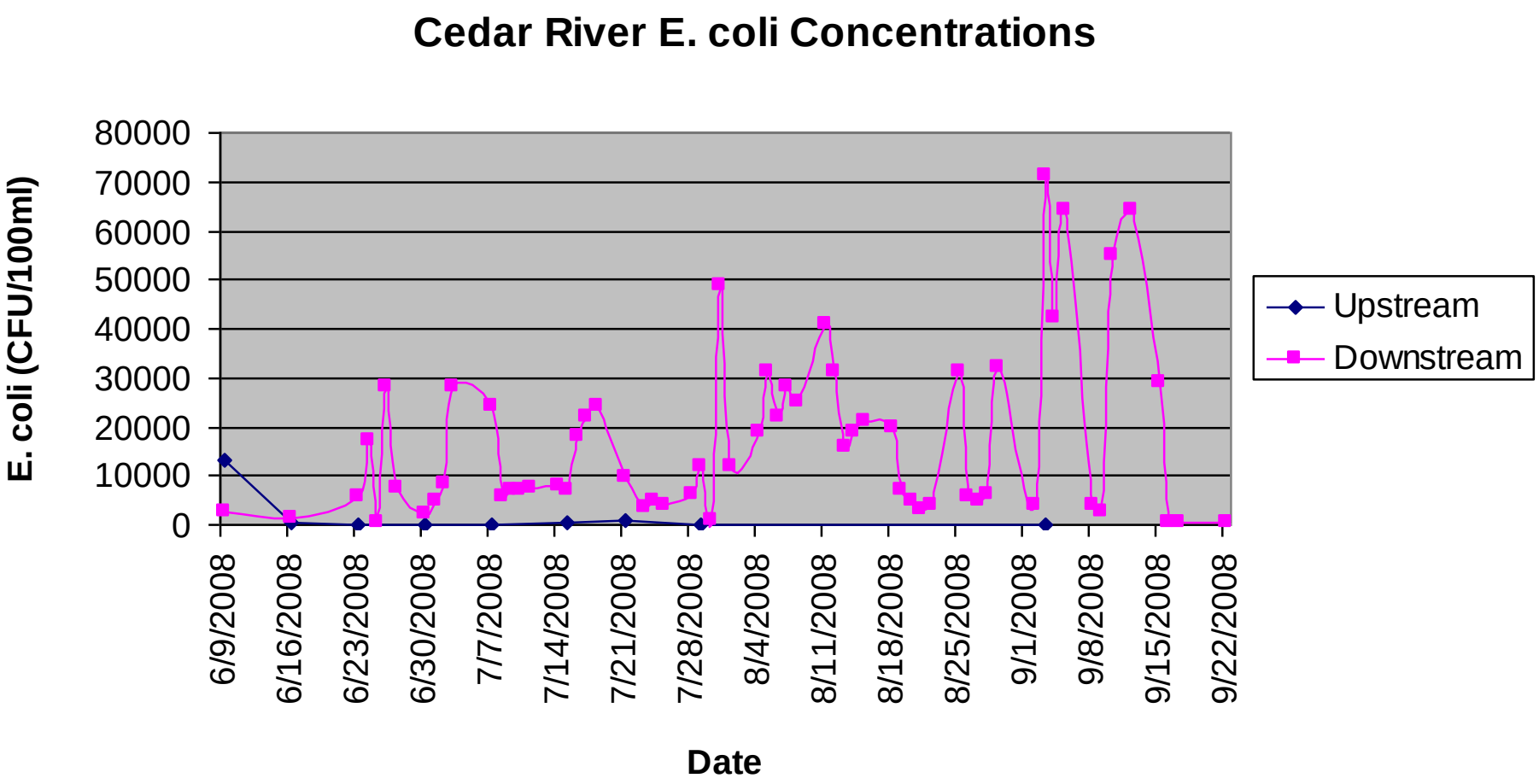


Increase in Cyanobacteria Blooms in summer 2008
(threatened Drinking Water of Des Moines)

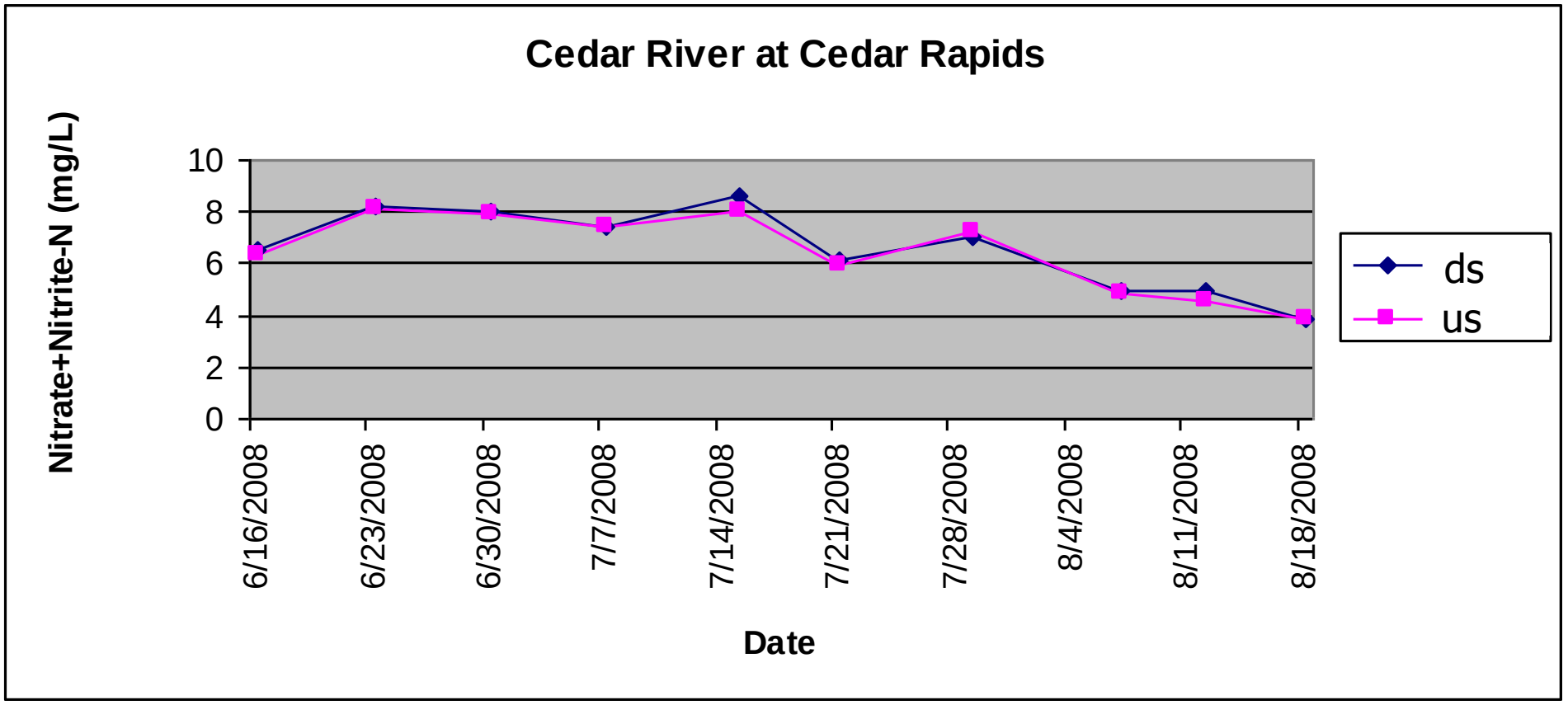


Median Concentrations (indicated on bars)
Compared to the statewide median (2000-2007; 110 CFU/100ml)

Cedar Rapids Example



Upstream values in blue; downstream in pink. Disinfection started 9/15/08


Cedar River at Cedar Rapids
Nitrate+Nitrite-N (mg/L)
10
8
6
4
2
0
6/16/2008
6/23/2008
6/30/2008
7/7/2008
7/14/2008
7/21/2008
7/28/2008
8/4/2008
8/11/2008
8/18/2008
Date
ds
us

Water Health Impacts

- EPA calculated "short-term" health guidelines
- None were exceeded (or even close….)

Severe Erosion Damage

- 20 tons per acre soil erosion:
  2,284,000 ac.

- Bottomland scouring:
  636,000 ac.

Photo from NRCS

After the Flood: Sediment Contamination?

Sediment Samples

- Most analytes not detected
  - June – August 96% non-detections
- Bacteria levels ranged from very high to low depending on the site conditions
  - 2 MPN/g to >24,000 MPN/g in Marshalltown

City Park,
Iowa City

Sediment Samples

- Consistent Low-level Detections of:
  - Metals
    - Arsenic, Chromium, Copper, Lead, Zinc
  - Motor Oil
    - 8 to 1900 mg/kg
  - Acetone
    - 10 to 66 ug/kg
  - Atrazine
    - 0.01 to 0.039 ug/kg

Potential Health Effects - Sediment

- Sediment data were reviewed by IDNR Contaminated Sites Section Staff
- Only one sample (Lead) above State Standards or Guidelines.
- Contaminated Sites Section – Lead guideline assumes children eating 200 mg of soil for 350 days/yr for 6 yrs plus an additional 100 mg/day for 350 days/yr for another 24 years.

Flood Sediments vs. State Standards

Chemical	Max Concentration	Statewide Standard
2-Butanone (MEK)	20 ug/kg	46,000,000 ug/kg
4-Methyphenol	860 ug/kg	310,000 ug/kg
Acetochlor	0.12 mg/kg	1,200 mg/kg
Acetone	66 ug/kg	68,000,000 ug/kg
Atrazine	0.039 mg/kg	2,100 mg/kg
Bis(2-ethylhexyl)phthalate	750 ug/kg	170,000 ug/kg
Diesel Fuel	60 mg/kg	3,800 mg/kg*
Dimethenamid	0.02 mg/kg	No standard**
Ethylbenzene	22 ug/kg	7,600,000 ug/kg
Gasoline	1.7 mg/kg	No standard
Motor Oil	1900 mg/kg	Unlimited
Pendimethalin	0.011 mg/kg	2,400 mg/kg
Arsenic	4.8 mg/kg***	17 mg/kg
Chromium (+6)	80 mg/kg	210 mg/kg****
Copper	270 mg/kg***	No standard
T E H	1,900 mg/kg	3,800 mg/kg*
Lead	2,900 mg/kg	400 mg/kg
Nickel	58 mg/kg	1,500 mg/kg
Zinc	1,500 mg/kg	23,000 mg/kg

* UST Standards

** Previous UST gasoline standard was 100 mg/kg; Benzene SWS=88mg/kg

***Typical concentration found in soil

****SWS for more likely chromium (+3)=97,000mg/kg

*****No statewide standard currently set, but would be large

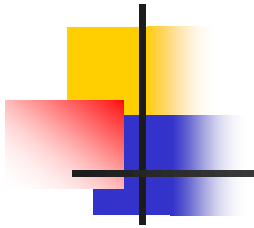
Lessons Learned

- Water Monitoring
  - Increase information flow to front line of responders (ex. county/city health)
  - Examine methods of information transfer (see above, targeted pamphlets, others?)
  - Prepared Guidelines for Clean-up
  - Human health vs. Environmental health
  - Improve monitoring – faster results, targeting areas of concern, differentiate flood and post-flood concerns
  - Concentration vs. Loads
- Flood Hydrology
  - Floods are natural phenomena. Have the "natural" hydrographs changed? Peak flows vs. flood volume

Sampling Challenges…..

Floods of 1993 vs. 2008

- 2008 Flood
  - Earlier in the year, more cumulative ppt earlier
  - More bare ground
  - Less vegetation
  - Saturated soils?
  - Most rainfall in 15-day period
- Questions
  - Tiles
  - Floodplain encroachment
  - Changing agricultural practices (ethanol)



Prediction in Ungauged Basins

"Due to non-stationarity of climate and the ever increasing human impact on the environment past data are not very relevant for decision about future behavior of the hydrologic system. Therefore, all basin are ungauged."

Sivapalan, M., Takeuchi, K., Franks, S., Gupta, V., Karambiri, H., Lakshmi, V., Liang, X., McDonnell, J., Mendiondo, E., O'Connell, P., Oki, T., Pomeroy, J., Schertzer, D., Uhlenbrook, S., and Zehe, E., IAHS decade on predictions in ungauged basins (PUB), 2003-2012: Shaping an exciting future for the hydrologic sciences, Hydrological Sciences Journal, 48(6), 857-880, 2003.


Thank You

Contact Information

Mary Skopec
Watershed Monitoring and Assessment
109 Trowbridge Hall
Iowa City, IA 52242
(319) 335-1579
Mary.Skopec@dnr.iowa.gov

Help Clean Up The Cedar River on AWARE 2009….